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# 100 kV DC RAMP TEST SYSTEM FOR TURBO-GENERATORS

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A high voltage dc supply which provides a uniformly increasing dc voltage at a selectable rate of voltage rise has been constructed. This new "DC Ramp" supply is capable of achieving 150 kV, more than sufficient for testing of the largest generator windings in the Ontario Hydro system. The dc ramp test is one of several tests used to evaluate the integrity of generator stator insulation during commissioning and maintenance.

## INTRODUCTION

Applying a gradually increasing dc voltage to a generator winding, up to the hipot test voltage, is a common means of assessing the insulation condition, while having assurance that flashover is not imminent. During the recent commissioning of a turbo-generator at Bruce "B" NGS, it became apparent that the existing dc ramp test unit [1] was not capable of testing to the 70 kV level required for 24 kV turbo generators. This report describes a new ramp test unit capable of 100 kV or more, while supplying 5mA.

## SYSTEM DESCRIPTION

The new ramp test unit is based on the Glassman 150 kV dc power supply with its programmable output voltage feature. The Glassman dc power supply is capable of being programmed to up to 150 kV in both positive and negative polarities. The output voltage is controlled by a 0 - 10 V dc input voltage, derived

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| 15-107-221 | 811.41 | March 24, 1987 | 87-28-K |

from a programmable digital-to-analog (D/A) power supply. The block diagram of the new ramp test unit is shown in Figure 1.

The HP 85 computer acts as a controller for all the other peripheral devices. These devices include the D/A Power supply, Glassman Programmable Power supply and an XY Recorder. The HP 85 has software to control these other devices (Appendix 1). The HP 85 sends a signal to the D/A power supply which the D/A supply converts to a voltage between 0 and 10 V dc. This 0 - 10 V dc voltage is then fed into the input of the Glassman power supply, producing an output voltage which is linearly proportional to the input voltage. Therefore, under control of an HP 85 program, the Glassman supply can be made to increase its output voltage at a selectable rate of voltage rise. A hard copy of the current versus voltage graph is provided by an XY recorder, connected to monitor the outputs of the Glassman supply.

## DC Ramp Test Procedure

The HP 85 Computer is connected to the HP 59501A D/A Power Supply via the IEEE 488 digital interface bus (Figure 1). The output of the D/A power supply is fed to a digital voltmeter and the input of the Glassman Power Supply Controller. The high voltage output from the Glassman controller goes directly to the associated high voltage stack. The Voltage Monitor and Current Monitor outputs from the Glassman control unit are fed into an XY recorder to get a plot of current vs. voltage from the ramp test.

The listing of the program software can be found in Appendix 1. Prompts are given by the HP 85 to select the maximum test voltage and the desired rate of voltage rise.

## CONCLUSION

The purpose for the development of this system is to facilitate dc ramp testing of generators to voltages higher than 40 kV dc. This new system is capable of output voltages of 0 to 150 kV in positive and negative polarities. The rate of rise of the

output voltage is programmable at either 2kV/min or 5 kV/min. Other rates-of-rise are available if the need arises.

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GLP JAD:msf

Reference

1. M. Kurtz, "The High Voltage Ramp Test Set," Research Division Report E75-81-K, Dec. 1975.

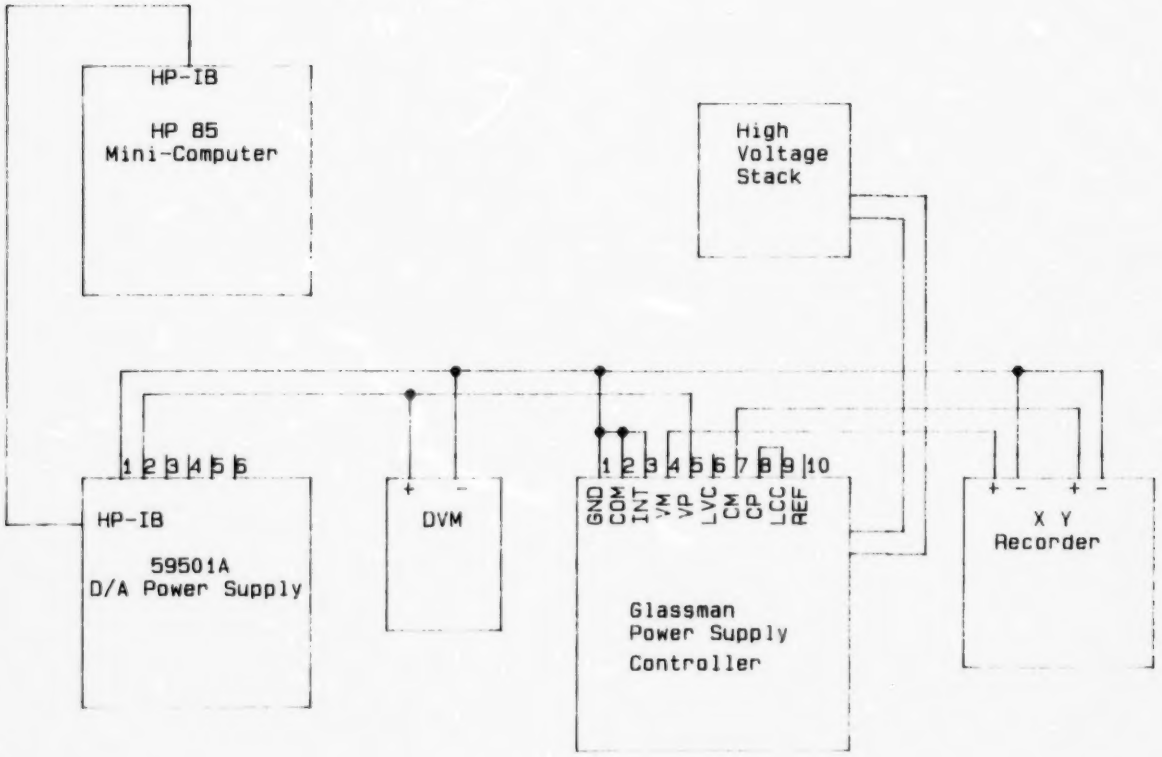


Figure 1

Ramp Test Set Up

Appendix 1

```
10 CLEAR
20 DISP "DC RAMP TEST"
30 DISP "PROGRAM FOR GLASSMAN"
40 DISP "POWER SUPPLY"
50 WAIT 10000
60 CLEAR
70 DISP "NO LOAD SHOULD BE CONN
   ECTED"
80 DISP "TO POWER SUPPLY DURING
   "
90 DISP "CALIBRATION PROCEDURE"
100 DISP
110 DISP "ENTER 1 IF NO LOAD CON
   NECTED"
120 DISP "ENTER 2 IF LOAD CONNEC
   TED"
130 INPUT L
140 IF NOT (L=1 OR L=2) THEN 110
150 IF L=1 THEN GOTO 210
160 IF L=2 THEN GOTO 170
170 CLEAR
180 DISP "DISCONNECT LOAD,YOU HA
   VE 30 SECS"
190 WAIT 30000
200 GOTO 110
210 DISP "SET 59501A TO UNIPOLAR
    MODE"
220 WAIT 5000
230 CLEAR
240 OUTPUT 714 USING "4D" ; 2000
250 DISP "SET ZERO ADJ FOR 0.00V
   "
260 WAIT 10000
270 CLEAR
280 OUTPUT 714 USING "4D" ; 2999
290 DISP "SET D/A FS ADJ FOR 9.9
   9 V"
300 WAIT 10000
310 CLEAR
320 OUTPUT 714 USING "4D" ; 2000
330 DISP "ENTER DESIRED OUTPUT"
340 DISP "VOLTAGE IN KV"
350 INPUT V
360 LET J=V/15+.2
370 LET M=INT(J*1000+.5)/1000
380 DISP "TURN VOLTAGE CONTROL"
390 DISP "POT OF GLASSMAN"
400 DISP M;"TIMES"
410 WAIT 10000
420 CLEAR
430 DISP "TURN GLASSMAN DC POWER
   "
440 DISP "SUPPLY OFF AND GROUND"
450 WAIT 15000
460 CLEAR
470 DISP "CONNECT HIGH VOLTAGE O
   UTPUT"
480 DISP "OF GLASSMAN TO LOAD"
490 WAIT 30000
500 IF V<100 AND V>0 THEN GOTO 5
   50
510 DISP "EXCEDING LIMIT OF POWE
   R SUPPLY"
520 WAIT 5000
530 CLEAR
540 GOTO 330
550 LET N=INT(V*6.7+2000)
560 IF N>2670 THEN GOTO 510
570 CLEAR
580 DISP "ENTER 2 FOR 2KV/MIN OR
   "
590 DISP "5 FOR 5KV/MIN RATE OF
   RISE"
600 INPUT R
610 IF NOT (R=2 OR R=5) THEN 580
620 IF R=2 THEN T=4500
630 IF R=5 THEN T=1800
640 CLEAR
650 DISP "ENTER R FOR RAMPING TO
    BEGIN"
660 INPUT X$
670 IF X$="R" OR X$="r" THEN GOT
   O 690
680 IF NOT (X$="R" OR X$="r") TH
   EN GOTO 650
690 CLEAR
700 U=2000
710 OUTPUT 714 USING "4D" ; U
720 DISP "RAMPING DC OUTPUT ON"
730 FOR U=2000 TO N STEP 1
740 OUTPUT 714 USING "4D" ; U
750 WAIT T
760 NEXT U
770 BEEP
780 DISP "RAMPING OUTPUT COMPLET
   E"
790 DISP "PEN UP"
800 WAIT 3000
810 OUTPUT 714 USING "4D" ; 2000
820 CLEAR
830 DISP "RAMPING OUTPUT COMPLET
   E"
840 END
```

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